Support of the European Commission funded Phare and Tacis Nuclear Safety Programmes by the Joint Research Centre (JRC)

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1. Introduction

The EU's strategy for improving nuclear safety in central Europe and in the New Independent States (NIS) is based on the G7 strategy adopted in 1992 and reflected the IAEA's classification of design and operation risks regarding nuclear reactors. One of the principal tools that the Commission put into place to implement this strategy was the 'Master Plan', a method for evaluation in twelve key practical safety areas, mainly for the VVER type reactors, along the line of the IAEA classification. For the RBMK reactors, the Tacis technical assistance programme, which is focused on the New Independent States (NIS) has funded an important generic and comprehensive safety assessment performed by a consortium of firms with Russian participation. In addition special assistance projects have been implemented for the Chernobyl closure and the "sarcophagus".

The master plan of the European Commission to evaluate the key safety issues includes the following 12 items [1]:

1. Integrity of the primary circuit
2. Instrumentation and control
3. Accident analysis
4. Training and Simulators
5. Fire Protection
6. Seismic Analysis
7. Containment/Confinement
8. Maintenance
9. Emergency preparedness
10. Waste and fuel cycle
11. RBMK projects
12. System Analysis

The PHARE and Tacis programme respectively dedicated to Central European and NIS countries cover the following broad areas: On-Site Assistance (OSA) and operational safety, design and beyond-design safety, off-site emergency preparedness and waste management. Support to Regulatory Authorities (RA) and their Technical Support Organisations (TSO) are provided by means of specific assistance contracts. Furthermore,

programs are dedicated to the control of nuclear materials and to the conversion of nuclear military scientists.

The European Commission Directorate General JRC has institutes chiefly concerned with nuclear matters (JRC-ITU, IRC-IAM and JRC-ISIS), all involved in Design Safety Projects for Tacis and PHARE. JRC-IAM is the co-ordinator of this effort, which includes: TOR preparation and assistance, endorsement with the beneficiary countries, evaluations of tenders, as well as follow-up and assessment of the projects reports and results.

JRC-IAM is in particular involved in the On-Site Assistance (OSA) of 12 NPP sites in Russia, Ukraine, Kazakhstan and Armenia. The work includes the technical assistance for the implementation and follow-up of all Tacis OSA projects, as well as the review and assessment of: Terms of Reference (TORs), Technical Specification for equipment supply, Evaluation Criteria for equipment supply, Tender Dossiers, Evaluation Committee Reports.

Besides Design Safety, JRC-ISIS is strongly involved in the monitoring and evaluation of Phare and Tacis Technical Support Organisations (TSO) projects [2]. This includes the follow–up and the review of intermediate and final project reports. JRC-ISIS has received progress reports and technical reports of all TSO projects since 1996. To date reports related to about 50 projects have been scrutinized and 40 final reports have been reviewed.

Another large effort is the dissemination of Tacis results, which was started by JRC-IAM in May 2000. The aim is to disseminate the description summaries of 700 Tacis projects, with special attention to 12 projects on design safety for which also summary reports, workshop papers and press releases are made available. Ways to disseminate this information include a bi-lingual Website, seminars in Russia and distribution of documents in digital form and or paper.

In the following sections the activity of JRC in support to PHARE and TACIS projects related to nuclear reactors safety is presented. It is worthwhile to recall that JRC is very much involved also in the Safeguard projects related to the control of nuclear material. JRC directly executes a number of projects in this area. As a remarkable achievement a training centre for nuclear inspectors has been recently set-up by JRC-ISIS in Obninsk. Due to the focus of the forum, Safeguard projects will not be considered further in this paper.

In section 2 the contribution to design safety projects is discussed. In section 3 the activity in support of on site assistance projects is presented. Section 4 discusses the monitoring and evaluation activity of TSO projects. In section 5 the outcomes of the "Tacis Technical Workshop, Mechanisms for Success" organised in October 1999 are briefly recalled with emphasis on the discussions held in the "Licensing Process & Reactor Safety" Working group. Section 6 is dedicated to the activity of dissemination of

Tacis projects results. Findings from some selected projects are presented in Section 7. Finally some conclusions are presented in Section 8.

2. JRC contribution to Design Safety

The direct internal customer for the for the design safety work is the Directorate General RELEX, concerned with the Commission external relations activities. The work is defined in multi-annual Workplans; the support for design safety projects deals with all aspects of projects life cycle, namely:

- TOR preparation and assistance,
- endorsement with the beneficiary countries,
- evaluations of tenders,
- follow-up and assessment of the project reports and results.

For running design safety projects, JRC receives Technical Reports as they arise, including the Final Report. The JRC review of each report is an integral part of the final review report, which is finally delivered to SCR either after review of the Project Final Report, or at the end of the Workplan. In the later case, the review is updated during the next Workplan upon receipt of the Project Final Report.

2.1 Reviewing Process

The structure of the review is defined according to the needs of the DG SCR. It begins with a project overview, using the project summary report and the contract requirements and recalling the objectives.

The project overview (based on the summary report and contract requirements) includes the objectives, tasks and activities performed; the difficulties encountered and the checking of deliverables: documents provided and whether they are included in the Final Report. .Moreover, it includes a clear identification of the deliverables (Report type/title/date) and of the composition of the deliverables.

The report review (or Analysis or Assessment) includes: the review of tasks; review of deliverables; review of results and project's conclusions; assessment of the technical data used for the project, in particular input data; assessment of the complete technical execution of the tasks, as planned in the TOR and in the contract and also the assessment of the technical validity of the work performed

The main points of the review are: Report readability and usability: links between each part of the Final Report; Methodology: Technical adequacy of the method used; quality of the summary report and the reports included in the Final Report, quality of the results and of the project's conclusions; compliance of the project with the contract; progress against time schedule; compliance with the contract objectives and tasks (activities); identification of shortcomings are clearly identified as well as areas needing clarification

or explanation. Also the consistency with the approach adopted in similar projects is checked and proposals for follow-up actions are considered.

The reviews of JRC refer essentially to technical aspects of the relevant project. The main review findings (Global conclusion) include: Overall assessment and contract (TOR and Annexes) fulfilment; technical shortcomings and the determination whether a part of the planned work is not performed; specific comments and remarks on the technical quality and further usability of this work.

As an example, the Tacis projects in Russia and the Ukraine that have been reviewed by JRC are shown in Table 1.

Table 1: RUSSIA and Ukraine - Report Reviews, Design Safety Projects

RUSSIA and Ukraine - Report Reviews, Design Safety Projects		
Project Nº	**Project title**	**Reviewer**
T1.1/91	Reactor Vessel Embrittlement	IAM
T1.4/91	PSA: Probabilistic Safety Analysis	ISIS
T1.6/91 & R4.01/93	Radwaste treatment Radwaste treatment of VVER 213 and VVER 1000	ITU
T1.9/91	VVER 230 – Operating procedures	IAM
T1.2/91	Primary Circuit Integrity: application of Leak Before Break concept to VVER 440-230	IAM
T1.13/91	Safety related equipment qualifications under accident conditions	IAM
T1.14/91	Residual lifetime evaluation	IAM
T3.1/91	PSA Technology	ISIS
T3.5/91	Maintenance	IAM
T3.8/91	Severe accidents and accident management	IAM
R1.04/91	Project 1.4 Probabilstic Safety Analysis - Novovoronezh Unit 3 application	ISIS
R3.1/91	Final Level 1 PSA Report for Reference Power Plant Balakovo Unit 4 (VVER 1000/320)	ISIS
R2.08/92	Stress analysis in VVER 1000 containment	IAM
R2.09/92	Assistance in development of regulatory documents and guidelines for I & C systems in NPPs	ISIS
R2.0/93bis	VVER ISI Methodology – Non Destructive Examination / In-Service Inspection	IAM
R2.07/93	VVER 1000 Core Analysis	ISIS
R2.08/93	Optimisation of maintenance on VVER 1000	IAM
R4.04/93	Radwaste management scheme at Moscow region	ITU
G4.2/93	Remediation concept for uranium	ITU

R1.04/94A	"All Station Computer Network" associated to a Technical Assistance job in Leningrad NPP	ISIS
R1.09/94	Maintenance training centre support for NPP personnel	IAM
R2.04/94 &R2.05/94	Water Level Instrumentation for VVER RPV & Modernisation of Neutron Flux and Temperature Measurement	IAM
R2.07/94	Dynamic Calculations of NPP Structures Against Seismic Events	ISIS
R2.09/94	Integrity Assessment of VVER 1000 RPVs Including Embrittlement Aspects	IAM
R2.13/94	Simulator training programme and documentation for Kalinin NPP simulator	IAM
R2.30/94	Transient analysis on the basis of improved computer codes for RBMK Reactors (Phase 1)	ISIS
R2.31/94	Leak Before Break Concept Applicability Evaluation (RMBK Reactors)	IAM
R3BREM/94	RBMK Core Physics	ITU
R4.01/94	Safety analysis and environmental impact of the storage facility of VVER-1000 spent fuel at Krasnoyarsd	ITU
R4.04/94	Improvement of the Sergiiev Posad storage and conditioning facility	ITU
R4 05/94	Feasibility study for St-Petersburg waste management centre	ITU
R1.04/95A	General Operational Assistance at Leningrad NPP-Fire Protection of Steel Structures at Leningrad NPP	ISIS
R2.06/95	Severe Accidents on VVER-1000	ISIS
R2.07/95	Early Failure Detection System	ISIS
R2.08/95	FP Retention System for VVERs	ISIS
R4.12/95	Improvement of the safety of radioactive waste management in the North-West region of Russia	ITU
R1.04/96A	Leningrad NPP: General On Site Assistance	ISIS
R2.02/96	Emergency protection signal effectiveness evaluation	ISIS
R2.07/96	Classification of actuators and I&C	ISIS
R2.08/96	Fire risk assessment for all types of reactors	ISIS
R7.04/96	Kalinin Nuclear Power Plant Unit 3	IAM
U1.02/92A2	Evaluation of Reactor Pressure Vessel Embrittlement of South Ukraine NPP Including Embrittlement Aspects	IAM
U4.02/94	Requirement for spent fuel storage, design storage facilities	ITU

The wide range of needed expertise, from PSA to design basis and severe accident analysis, seismic qualification and structural aspects to waste management, is provided by the various institutes of the JRC in consequence of their competence resulting from the running research activities.

3. Tacis On-Site-Assistance (OSA)

The specific tasks to be executed by the JRC-IAM under the present Work Plan are dedicated to the supervision of the On-Site Assistance in CIS, and cover a period of 36 months. The plants are located in Russia, Ukraine, Armenia (1) and Kazakhstan (1). Activity covers:

1. Technical Specifications
   Check of Technical Specifications in terms of quality and neutrality (prepared by the Western utilities in the framework of the On-Site Assistance (OSA) programme) (see projects concerned in table 1).

2. Approval of the evaluation criteria
   To define for the open tenders the different evaluation criteria specific for every project.
   To proceed to the harmonisation of the criteria.

3. Approval of the composition of the Evaluation Committees
   Analysis and approval of expert profiles to make up the Evaluation Committee.
   The JRC will be in charge of the Presidency of the Committees.

4. Approval of Technical Dossiers
   Analysis and approval of the technical part of the dossiers answering to the tendering.

5. Approval of Technical and financial Evaluation Reports
   Analysis and approval of the technical and financial evaluation reports.

6. Assessment of the OSA reporting and feed-back to the Contractors

7. Preparation of the Terms of Reference (Annexe A) and approval of the contract

8. Management and evaluation of the OSA programme
   Assistance follow-up at the 12 Tacis nuclear power plant sites, with interviews with the local E.U. utility doing OSA and possibly with the local Beneficiary, definition of a strategy

9. Participation to the 2 + 2 approach of Utilities
   Safety Authorities concerning the 12 Tacis nuclear power plant in co-ordinating the policy implementation to the E.U. utilities doing OSA and possibly to the local Beneficiary

A list of the main safety related Tacis projects under the OSA agreement and the interested sites is shown in Table 2. The On-site work is centred at JRC-IAM, Petten (NL).

Table 2 : Main Tacis On Site Assistance Projects supported by JRC-IAM.

Project	Equipment	Site
A1.01/96 B	Improvements to fire protection system	Medzamor NPP
A1.01/96 F	Leak detection	Medzamor NPP
A1.01/96 G1	Pressuriser Safety valves	Medzamor NPP
A1.01/96 G2	Steam Generator Safety valves	Medzamor NPP
A1.01/96 H	Primary circuit integrity verification	Medzamor NPP
A1.01/96 J	Confinement tightness improvement	Medzamor NPP
R1.01/94 C	Safety Valves on SG	Kola NPP
R1.01/94 D	Leak detection system N-16	Kola NPP
R1.01/95 A	Fire Detection System	Kola
R1.01/96 A	Steam generator leak detection system	Kola NPP
R1.01/96 B	Tritium measurement equipment	Kola NPP
R1.02/94 E	Safety valves	Balakovo
R1.02/94 G	Fire-fighting equipment	Balakovo
R1.02/96 C	Supply & installation/filtration equi. inlet emergency core cooling syst.	Balakovo NPP
R1.03/94 G	Safety valves	Kalinin
R1.03/94 J	H2 recombiner in containtment	Kalinin
R1.04/94 F	Emergency Fire Alarm	Leningrad NPP
R1.04/95 A	Upgrading fire resistance	St. Petersburg
R1.05/94 A	In-service inspection	Smolensk
R1.05/94 B	Valve diagnostic system	Smolensk
R1.05/94 D	Safety valves	Smolensk
R1.05/95 A	Leak before break detection equip.(RBMK)	Smolensk
R1.05/96 B1	NDT of NPP components	Smolensk NPP
R1.06/94 B	Equipm. repair safety valves	Beloyarsk NPP
R1.06/95 C	Sodium level indicators	Beloyarsk
R1.06/95 D	In Service Tritium Monitoring	Beloyarsk
R1.07/94 A	Fire protective clothing	Aktau
R1.07/96 D	Equip. supply for functionality existing diagnostic systems	Novovoronezh NPP
R1.08/95	Emergency power supply system	Bilibino
U1.01/95	Valves replacement unit 1 & 2	Rovno Npp
U1.02/96 A	Improvement fire protection system	South Ukraine NPP
U1.03/94 A	Fire Protection Equipment	Zaporozhe
U1.03/94 B	Hydrogen Monitoring. Equipment	Zaporozhe

4. Technical Support Organisation (TSO) Phare and Tacis Projects

The TSO support work is executed by JRC-ISIS that has been active since 1996 in the monitoring and evaluation of Phare and Tacis Technical Support Organization projects. To this aim yearly agreements have been signed between DG Environment and JRC ISIS. Project progress reports and technical reports are sent by DG Environment to JRC-ISIS on a regular basis and projects are closely monitored and evaluated by JRC-ISIS. JRC-ISIS reviews are delivered to DG Environment which ensures their distribution to DG SCR and other related EC services. In order to ensure a consistent and homogeneous treatment by the various reviewers involved in the different projects, a review template and a manual for reviewers have been set-up. Each review conforms with the structure reported below:

1. Introduction.

2. Project Identification and Progress including: Project identification and Progress against project time scale.

3. Project overview including: Background, Objectives of the project, Terms of Reference (TOR).

4. Compliance of Project with Terms of Reference including: Objectives of the project, Specific Tasks, Other Terms.

5. Technical adequacy of methods used including: JRC review conduction and limits and technical assessment of Project-specific findings.

6. Consistency with approach adopted in related projects.

7. Review findings including: TOR fulfillment and report readability and usability.

8. Conclusions, References and List of Acronyms.

The structure for the reviews has similarities with and differences from Design Safety reviews. To date the cumulative number of Phare and Tacis TSO projects monitored by JRC-ISIS is around 50. About 40 final reports have been reviewed and around 300 intermediate progress and task reports have been scrutinized. The technical areas covere accident analysis and accident management, safety evaluation and licensing, structural aspects, waste decommissioning and radiation protection. Special projects are dedicated to the Chernobyl shelter and decommissioning and waste management at the Chernobyl site. Table 3 presents the different TSO projects reviewed by JRC-ISIS as of June 30, 2000. The beneficiary countries can be identified from the Project Reference. Finally Table 4 (adapted from [2]) presents the different topics addressed in the TSO projects reviewed by JRC-ISIS at the date of June 30, 2000. It appears that the majority of the projects are dedicated to issues related to safety evaluation & licensing, while other specific topics are addressed by a reduced number of targeted projects.

Table 3: PHARE and Tacis TSO Projects evaluated by JRC-ISIS.

Project Ref.	Project Title
AP/UK/TS/01	Preliminary Safety Objectives for the Future of the Chernobyl Unit 4 Shelter.
AP/UK/TS/02	Support to Ukrainian regulatory authorities for the licensing activity related to the decommissioning and waste management at Chernobyl NPP.
AR/TS/01	Assistance to the Armenian Nuclear Regulatory Authority for Licensing Related activities (independent review) of Medzamor Unit 2.
AR/TS/02	Assistance to Armenian NRA for licensing related activities of Medzamor Unit 2-second step
BG/TS/01-D	Kozloduy NPP, Unit 1-Status and Analysis of the Implementation of the Outage Programme.
BG/TS/01-F	Assistance to BNSA. Kozloduy 1, 3 and 4. Assessment of the upgrading Measures of Kozloduy 3 and 4 and of operational safety
BG/TS/02	Fuel Rod Modelling and Performance (Feronia).
BG/TS/03	Assistance to BNSA, Safety Assessment of Kozloduy Unit 5&6 and Licensing of the Related Utility Improvement Programme including Review of PSA
BG/TS/04	Assistance to BNSA in the Development of Requirements and Procedures for Decommissioning of Kozloduy Units 1 and 2.
BG/TS/05	Assistance to BNSA. Kozloduy 1, 3 and 4. Assessment of the upgrading Measures of Kozloduy 3 and 4 and of operational safety.
BG/TS/07	Nuclear Safety Expert for the Modernisation Project Kozloduy 5 & 6.
CZ/TS/01	Licensing related assessments for design and operational safety of VVER 213.
CZ/TS/04	FERONIA (Fuel Rod Modelling & Performance).
HU/TS/01	Licensing Related Assessments for Design and Operational Safety of VVER-213 Safety Improvement Programme and On-Site programme (Paks Units 1,2,3,4).
HU/TS/02	Topical Issues Concerning Accident Analysis: Methodologies and Management (Paks Unit 1,2,3,4)
LI/TS/01	Formation of a TSO Function-Lithuanian Metal Control Laboratory.
LI/TS/02	Enhancement of Lithuanian TSO's capability.
LI/TS/12	TSO Support to VATESI during Application of SAR and RSR Results in the Licensing of Ignalina NPP.
LI/TS/14	TSO Support to VATESI during Application of SAR and RSR Results in the Licensing of Ignalina NPP-Second Phase.
PR/TS/02	Emergency preparedness for on- and off-site methodologies and software tools for emergency technical centers.
PR/TS/08	EU TSO Support to CEEC and CIS Nuclear Regulatory Authorities and their TSOs in the Safety Related Evaluation the VVER 420/213 Bubble Condenser Experimental Qualification Project.
RF/TS/01-A	Licensing Related Assessment of the Accident Analysis performed for the VVER 230 project - Kola Units 1,2.
RF/TS/01-B	Licensing Related Assessment of Safety Associated Modernisation of VVER-440-230 (Novovoronezh NPP Units 3 & 4.

RF/TS/01-C	Licensing related assessment of reactor vessel embrittlement.
RF/TS/01-D	Licensing related assessment of the primary circuit integrity of VVER 440/230. Application of Leak before break concept.
RF/TS/01-E	On site assistance and modernisation for NPP with VVER 440/230 KOLA 3-4.
RF/TS/01-F	Licensing related assessment of design and operational safety for VVER 1000 safety improvement programme and on-site programme of individual plant (Balakovo).
RF/TS/02	Assessment of Severe Accident and Accident Management.
RF/TS/03	Licensing related assessment of design and operational safety for fast reactors.
RF/TS/05	Technical basis for Russian and West European NDT qualification.
RF/TS/06	Evaluation and development of technical basis for ensuring the safe decommissioning of nuclear facilities.
RF/TS/07	Evaluation of the Current Status and Development of Licensing Procedures for Radioactive Waste Management for the Russian Federation.
RF/TS/10	Support to the Review of the In-Depth Safety Assessment of the Leningrad NPP Units 1, 2, 3 and 4.
RF/TS/13	TSO Support to Independent Safety Related Analysis of Russian NPPs by Application of Western European Codes.
RF/TS/15	TSO Support of Gosatomnadzor of Russian Federation in the Review of NPP Fire Risk Evaluation.
RF/TS/19	Nuclear Safety Expert for the Modernisation Project Kalinin NPP Unit 3
RF/TS/20	Nuclear safety Adviser for the Modernisation Project Kalinin NPP Unit 3.
RF/TS/31	Licensing Related Assessments of Tacis Financed On Site Assistance projects in the Russian Federation.
RF/TS/VVER/A	Support to The transfer of Accident Analysis Codes to the Russian Nuclear Safety Authority Gosatomnadzor and Technical Safety Organisations and Application of these Codes.
SK/TS/01	Licensing related assessment of design and operational safety for VVER 230 safety improvement programme and on-site programme (Bohunice units 1 and 2).
SK/TS/02	Licensing related assessment of design and operational safety for VVER 213 safety improvement programme and on-site programme (Bohunice units 3 and 4).
SK/TS/03	Licensing related Assessments of Design and operational safety for VVER-213 (Mochvce Units 1 and 2).
UK/TS/01-A	Safety Evaluation of VVER 440/213 and VVER 1000/320 Reactors in Rovno NPP Units 1, 2 and 3.
UK/TS/01-B	Licensing related Assessments for design and operational safety of VVER -440/213 and VVER-1000/320 Safety Improvement programme (Rovno NPP 1, 2, 3).
UK/TS/02	Evaluation report of the modernisation programme of Rovno 4 and Khmelnitzky 2 units and the safety upgrading of Zaporozhe 6 -
UK/TS/02-B	Participation to the Public Consultation in the frame of R4/K2 completion and upgrade project as independent safety expert.
UK/TS/04	Support to the Transfer of Accident Analysis Codes to the Ukrainian Safety Authority and its Safety Organisations (TSO) and Application of these Codes.
UK/TS/06	Support to the NRA in the field of safety assessment of neutronic design.
UK/TS/09	Support to Ukrainian NRA in Establishing a Code Certification System

UK/TS/11	Assistance in Strengthening the Ukrainan Safety authority. Analytical basis Necessary for performance of Radiation protection Calculations.
UK/TS/12	Assistance to the Ukrainian NRA for Licensing Activities Related to Shelter Implementation Plan.
UK/TS/20	Support to the Ukrainian NRA in Licensing Activities Related to Tacis/NSA Financed Decommissioning Facilities at Chernobyl NPP. -

Table 4: PHARE & Tacis, TSO Projects reviewed by JRC-ISIS sorted by subject.

Accident Analysis & Accident Management	
Methodologies and Codes	HU/TS/02, RF/TS/VVER/A, UK/TS/04, UK/TS/09, RF/TS/13
Emergency Management	PR/TS/02
Severe Accidents	RF/TS/02

Safety Evaluation & Licensing (excluding structural aspects)	
General Aspects	AR/TS/01, CZ/TS/01, HU/TS/01, LI/TS/12, PR/TS/08, RF/TS/01-A, RF/TS/03, RF/TS/10, SK/TS/03, UK/TS/01-A
Upgrading Measures	BG/TS/01-F, BG/TS/03, BG/TS/07, RF/TS/01-B, RF/TS/01-F, RF/TS/19, SK/TS/01, SK/TS/02, UK/TS/01-B, UK/TS/02, RF/TS/01-E, RF/TS/20, RF/TS/31
Neutronics & Fuel Rod Modelling	BG/TS/02, CZ/TS/04, UK/TS/06
Fire Risk Evaluation	RF/TS/15

Structural Aspects of Licensing & Non-destructive Testing, LBB
LI/TS/01, RF/TS/01-C, RF/TS/01-D, RF/TS/05

Waste Decommissioning & Radiation Protection
RF/TS/06, RF/TS/07, UK/TS/11, UK/TS/20, BG/TS/04

Chernobyl
AP/UK/TS/01, AP/UK/TS/02, UK/TS/12, UK/TS/20

Other
LI/TS/02

5. "Tacis Technical Worksop, Mechanisms for Success", Ispra 12/10/99.

The "Tacis Technical Worksop, Mechanisms for Success", has been organised in October 1999 by the Join Research Centre in collaboration with the Common Service for External Relations in order to investigate the mechanisms for success of Tacis projects and to discuss areas for improvement in the assistance process both form the technical and organisational point of view [3]. The workshop, chaired by the Russian Deputy Minister B.I. Nigmatulin and by the General Director of the JRC, H. Allgeier has been attended by a large number of EU contractors in Tacis projects with a wide representations from beneficiary Russian institutions. A number of successful Tacis projects were discussed in detail focusing on the reasons beyond the success of the assistance projects. Parallel working groups discussed in detail aspects related to:

- Nuclear Fuel Cycle
- Dissemination and Training
- Licensing Process and Reactor Safety
- European Networks: Material and Structural Integrity

In the Working Group on the Licencing Process & Reactor Safety, chaired by A. Kamaza of GAN, the licensing process in NIS and the support received in this context by means of Tacis projects were largely discussed and are summarised hereafter [3]:

An Exploratory Mission of the EC was held in Moscow in 1992. It reviewed the Russian Nuclear Regulatory system. In its report it was stressed that the guiding objective of Tacis programme was to assist the Russian Government to establish a legally-based independent and technically strong Regulatory Authority.

The key issues are to develop a framework for: a) Improvement of licensing systems, b) Adequate supervisory structures and c) Provision of resources and equipment.

As a positive result of implementation of Tacis projects, RF GAN considerably improved the legal basis and the licensing procedures and started to move from 'pure' control and supervision to regulation and licensing.

The Regulatory Pyramid (legal and regulatory documents for Nuclear and Radiation Safety) was established very successfully and was prepared and presented on a CD-ROM.

However, the absence of acting Russian Federal Law on compensation for Nuclear Damage and Nuclear Insurance defines the necessity of future support in this field.

The following recommendations were made at the workshop:

In spite of evident successes in the last years, RF GAN till now needs support in performing comprehensive technical reviews of documents submitted by industry to justify NPP safety in accordance with Russian rules and international practices. This area covers also Review of in-depth Safety Analysis Report (RSAR).

This support could be more effective in the case that experts from both sides would have possibility to plan their future activity in the frame of Tacis project.

The approach '2+2' declared by EC, involving in parallel industry organizations and Regulatory Body and its TSOs, should deliver good results and can be recommended for future licensing activity.

To be sure in successful implementation of results of industrial Tacis projects, licensing following of these projects should be provided from the initial steps.

Approving the competitive approach based on tendering procedure related to industrial projects, it is important to stress the specific state of Regulatory bodies and their TSOs which require that the corresponding approach and rules are considered to prepare the contracts.

Thanks to EC support, an Emergency Centre has been created and an analytical simulator has been installed at RF GAN. However, due to financial problems a communication system between the emergency centre and NPPs was not created. International support in this field will allow solving many problems of regulatory activities.

6. Dissemination of Tacis project results

The project is part of the Tacis programme for the Russian Federation and is referred to as TOR-R8.01/97: "TRANSLATION, EDITING AND DIFFUSION OF DOCUMENTS" (Results dissemination). The aim of the project, run by JRC-IAM, is to identify Nuclear Safety projects that are already completed or under way, and to discuss their results in an adequate manner.

Twelve nuclear safety projects were chosen out of the Tacis 1991-95 programmes with the following criteria:

- Safety relevance;
- Ability to apply the results on similar cases or situation;
- Ability to initiate/promote in-depths changes in the Russian nuclear industry.

To date only Partners of each action are fully informed of results (Beneficiary, Contractors, Local Subcontractors, EC and concerned Safety Authorities). The objective is to amplify the effects of these safety-related results by information dissemination to Russian and Western organisations. To be efficient this dissemination is available also in the local language in order to be accessible not only to an elite but also to a much wider range of NPP actors (maintenance, operating, engineering, equipment manufacturing, ISI, material and equipment ageing…).

Table 5: List of the 12 selected projects to be disseminated.

Project reference	Project title
1.1/91	Reactor Vessel Embrittlement.
1.2/91	Primary Circuit Integrity._&_Application of Leak Before Break concept.
1.3/91	Accident Analysis.
1.13/91	Safety related equipment qualification under accident conditions.
3.2/91 and R2.10/93N	Quality Assurance Programme Development. Quality Assurance Programme Development (Extension of project 3.2/91).
3.5/91 and R2.08/93N	Maintenance on VVER-1000. Maintenance VVER 1000 (Extension of Tacis 3.5/91).
3.8/91	Severe accidents and accident management technology.
R2.05/93C	Non Destructive Examination in-service Inspection.
R2.09/94	Integrity assessment of VVER-1000 RPV including embrittlement aspects.
R2.13.94	Simulator training programme and documentation for Kalinin NPP simulator.
R2.30/94	Transient analysis on the basis of improved computer codes for RBMK reactors.
R2.31/94	Leak-Before-Break Concept Applicability Evaluation (RBMK Reactors).

To reach these goals, the results will be disseminated by the following ways:

- For all the chosen Tacis final reports, there will be written an "Executive Summary" (in English and Russian) widely distributed through mailing lists and publications in Russian technical journals. These executive summaries will be fully allowed for publishing and free of industrial property restrictions.
- A Web site will be set-up. This site, in the same manner as the existing Tacis site, would include a Tacis Welcome page, all Tacis project description summaries and all available project executive summaries (in English and Russian). A page informing about this Web site will be prepared and inserted, in the next Tacis programme book and in Russian technical journals.
- Seminars/Workshops will be organised in Moscow for Russians, Ukrainians and others Eastern countries (Armenia, Kazakhstan, PHARE countries…). This kind of workshop would be held each year in order to present the projects of the Tacis programme, which will be chosen for dissemination during the previous year.
- CD-ROM(s) will be edited to make available all information even to people not linked to the internet. This CD-ROM would contain project description summaries, press releases, executive summaries, view graphs and workshop transparencies (in English and Russian).

7. Some examples of relevant results from PHARE & Tacis Projects

A TSO Tacis contract on "Licensing Related Assessments of the Primary Circuit Integrity of VVER-430/230, Application of Leak Before Break (LLB) concept" (Tacis/RF/TS/01-D) led to the conclusion that it is possible to fulfil the LLB requirements for Kola 1 and 2 and Novovoronezh 3 and 4. This result suggests that LBB could be applied to all VVERs and possibly to the RBMKs. The highly relevant in-service inspection of primary circuit components is therefore the object of a present Phare project.

A Phare TSO project involved the development and validation of a VVER version of the well-known TRANSURANUS fuel pin thermo-mechanics code from JRC ITU (BG/TS/03). This was done for the Bulgarian TSO and involved also the training of Bulgarian personnel. After this project was finished, the Czech research centre of REZ also expressed interest in this code and a further Phare contract has been started (CZ/TS/04).

A completed Tacis contract on Design Safety (R2.07/93) deals with VVER-1000 Core Analysis. This dealt with Method Validation and the setting up of a Reference Core; Calculation of Nuclear Key Parameters; Reactivity Control; Power and Xenon Control and Low Leakage Strategies. The review states that the project has certainly met its terms of reference and did even more such as considering two advanced cores. The good agreement of the Western and Russian codes on the zero power and the VVER-1000 benchmarks give confidence that the safety parameter calculations which were subsequently done are also reliable. A great deal of Western expertise was conveyed to the Russians during this contract. But they also showed that they have high quality codes and that their safety requirements are sometimes stricter than the ones in the West.

A Tacis design safety project (R2.07/95) that is still underway concerns the completion of an early failure detection system for VVER-1000's. This System is important for helping reactor operators to identify the cause of a malfunction that is indicated by the regular control system. This system should eventually be installed on a VVER -1000 plant of the beneficiary Rosenergatom. The work performed so far agrees with the Specific Technical Terms of Reference. However, considerable work is still needed to implement and couple the Diagnostic system rules and the Human Machine Interface on the workstation of the beneficiary.

An important point considered since the beginning of PHARE and Tacis assistance in design safety project is the transfer and training of PSA methodologies applied to Eastern reactors for both NIS and CEEC countries.

In 1991, two large projects on development of PSA Technology for Russian type of reactors were initiated: Tacis projects T1.4/91, "Probabilistic Safety Analysis", and T3.1/91 "PSA Technology". One of the tasks consisted in a special application to perform a Level 1 PSA (considering internal initiating events) for the Balakovo Unit 4 (VVER 1000/320) designed to serve as a reference study for further plant-specific VVER

PSAs. Another task consisted in developing a level 1 PSA for VVER 440/230 plant types and the Novovoronezh unit 3 was chosen as specific application.

Further projects in the PSA area were usually extensions of these predecessor projects, such as project R2.01/96 "Design Safety VVER PSA Level 1 on VVER-230 (Novovoronezh 3)" with the main goal of developing a full scale PSA Level 1 for the Novovoronezh VVER 440/V230 NPP Unit 3 for internal initiating events:

- with respect to all basic conditions during plant operation (i.e.during power and "shutdown conditions") as well as
- with respect to all measures to enhance safety provided by the modernization program.

Other examples of more specific applications of PSA related technologies are projects R2.08/96, "Fire Risk Assessment for All Types of Reactors", and R1.04/95A "General Operational Assistance at Leningrad NPP Fire protection of Steel Structures at Leningrad NPP". These projects deals with plant-specific deterministic and probabilistic fire safety assessments and implementation of recommended measures to enhance safety.

In recent years, the focus shifted more towards aspects of operational safety, especially where older type of reactors are concerned. One example is project R2.04/97A, "In depth safety assessment of Novovoronesh 3&4 and Kola 1&2". The overall objective of this project is to provide support to the Beneficiary in order to analyse and evaluate operational safety within the context of In-depth Safety Assessment for NPP units under consideration. The units under consideration within the scope of this Project are the four VVER 440/V230 reactor design units of Kola 1&2 and Novovoronezh 3&4. The Project consists of two parts:

- Refinement of operational safety assessment methodology in the Russian regulatory authority Guidelines, utilising experiences from PHARE, IAEA, etc.;
- Operational safety assessment practical application to the 4 units.

The first activity will result in a generic approach, being in accordance with the regulatory requirements and international best practice, and applicable to all Russian NPPs. The second activity includes a practical application to the selected units.

As it is the case with most PSA-related projects, to ensure successful know-how transfer and training, a major part of the application work is carried out by the Russian Party. The Western Contractor's functions lie essentially in the training of Russian experts, the refinement of existing approaches and in the review of the application work.

Thus, in all these projects, the accomplishment of the various safety enhancement related goals involves transfer of Western PSA methodology and experience to the Russian counterpart extending the approaches taken in the "original" Tacis 1991 projects together with assistance and collaboration. This in order to allow beneficiaries to evaluate the safety of the plants, to support the decision making process related to design, operation

and maintenance and to confirm the validity of the modifications proposed by the Russian counterparts for reference plants. The efforts in the PSA area were largely successful when it was possible to build up a good working relationship between Western and Eastern partners, thus avoiding efficiency losses due to communication problems or redundancies of work. As safety assessment for both Western and Eastern reactors is a continuous process, and PSA being a continuously to-be-updated activity, the efforts in this area shall be continued.

8. Conclusions

The Tacis and Phare efforts have led to quite a few improvements in reactor safety in the NIS and central European countries. This is well captured on the web page of Tacis and Phare [1], an extract of which is given below.

Globally, the other result of the EU's efforts can be characterised as follows:

- In central Europe, the intensification of the enlargement process has had a major impact on the issue of closing less-safe reactors in the region.

- The Commission is now pursuing this goal through an active and comprehensive dialogue with the governments of the countries concerned;

- A significant contribution to addressing the problems related to the Chernobyl Nuclear Power Plant, notably the decommissioning of units 1 to 3, Shelter Implementation Plan for the destroyed reactor 4. In addition, the Commission has provided a substantial contribution to the implementation of the G7 policy for the closure of this plant by 2000;

- Independent regulatory authorities have been strengthened and the necessary legal framework for nuclear safety put in place in both central Europe and the NIS, although the quality of the regulatory authorities still varies from one country to another;

- There has been progress in strengthening the nuclear safety culture in the region, reflected notably by a more formal and regular dialogue between plant operators and regulators;

- Technical solutions to major design deficiencies have been provided to the extent possible;

- A significant contribution to the improvement of operational practices has been made and some plant modernisation has taken place through limited equipment deliveries;

- Some contribution to raising awareness of the problem of waste management;

- A significant contribution to the objective that the completion of any partially constructed reactor would be carried out at a high level of safety.

From a scientific point of view the Phare and Tacis programmes are not without interest beyond that of comparing approaches and designs. From the examples of section 7 and other JRC experience it is clear that important safety information has been acquired through the joint study between beneficiary organisations and Western Experts of VVER and RBMK designs, and one can foresee that collaboration rather than just assistance is the model towards which all parties involved are moving.

EC PHARE and Tacis projects will continue according to Commission Communication to the EU Council [4] and JRC support will play an increasing role in the future.

References

[1] http://europa.eu.int/comm/external_relations/nuclear_safety/intro/index.htm and go to bullet Tacis & Phare Nuclear Safety Programmes Implementation.

[2] G. Cojazzi, D. Fogli, P. Price, with contributions of: S. Contini, U. Graf, C. Kirchsteiger, A.V. Jones, I. Papadopoulos, G. Solomos, H. Wider, A. Yerkess, *Support to DG XI in Review of PHARE and Tacis "TSO Project" Reports, Final Report of the Administrative Arrangement N° B7-5200/97/000874,* EC-JRC Technical Note No. I.00.98, July, 2000.

[3] Proceedings of the "Tacis Technical Workshop, Mechanisms for success ", Organised by he European Commission the Directorates Generals "Common Service for External Relations" and "Joint Research Centre", with Mr. Bulat Iskanderovich Nigmatulin Vice-Minister MINATOM and Mr. Herbert J. Allgeir Director General of the JOINT RESEARCH CENTRE, Joint Research Centre, Ispra, Italy 11-12 October 1999, to be published.

[4] European Commission, COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT, Commission support to nuclear safety in the Newly Independent States and Central and Eastern Europe, Brussels, 6.9.2000, COM(2000) 493 final.